DETAILED ACTION

Claim Objections

Claims 20-21 are objected to because of the following informalities: "an electronic component *marking* method" appears to be typo. Appropriate correction is required to amend to "mounting method" as recited in claims 22-24. Also, with respect to claim 21, the phrase "higher *then* the" should be corrected to recite higher **than** the.

Claim Rejections - 35 USC § 103

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

1. **Claim 1** is rejected under 35 U.S.C. 103(a) as being unpatentable over Sakuyama et al. (JP 06061636 A, of record) in view of applicant admitted prior art ("AAPA").

a. **Regarding claim 1,** Sakuyama et al. **("Sakuyama")** discloses surface mounting components on a board substrate and specifically discloses separately applying unhardened resin and solder powder (i.e. paste) on the board (abstract). Sakuyama teaches first applying only resin on the bond areas 2 of the substrate 1, forming layer 3, and then subsequently applying the solder paste, forming solder layer 4. Thus, the resin is disposed between the paste and bond areas of the substrate (fig. 1). Sakuyama teaches heating the assembly to bond the components to the substrate, but fails to disclose placing components having

solder bumps on a printed paste on the circuit substrate. However, such technique is well-known in the art as shown by AAPA.

b. **AAPA** discloses an electronic component mounting method (fig. 10) in which joints between a circuit substrate (21) and electronic components (25/26) are made by placing the components 26 having solder bumps 26a on a printed paste 28 of circuit substrate 21 (fig. 10c) and then heating the assembly to bond the components on the substrate (fig. 10d). Sakuyama discloses surface mount components (which one of ordinary skill would appreciate as typically having solder bumps) and is not limited to specific type of components. Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to bond solder-bumped surface mount components similar to AAPA in the method of Sakuyama because such technique (bonding bumped components to printed paste on a substrate) was recognized as part of the ordinary capabilities of one skilled in the art and would have yielded the predictable result of providing reliable joints between the components and the substrate. As the process of Sakuyama in view of AAPA is indistinguishable from the claimed process, it would necessary flow that during the heating step in the method of Sakuyama, the solder paste would flow through the reinforcing resin and contact the bonds areas of the substrate in order to interconnect the substrate and the electronic components.

2. **Alternatively, Claim 1** is rejected under 35 U.S.C. 103(a) as being unpatentable over applicant admitted prior art ("AAPA") in view of Sakuyama et al. (JP 06061636 A).

c. **Regarding claim 1, AAPA** discloses an electronic component mounting method (fig. 10) in which joints between a circuit substrate (21) and electronic components (25/26) are made using solder paste (28). AAPA discloses placing components (26) having solder bumps (26a) on the circuit substrate (fig. 10c) and heating the assembly to bond the components on the substrate (fig. 10d). AAPA discloses printing solder paste on the bond area (fig. 10b), but fails to teach printing the paste on a reinforcing resin such that the resin is between the paste and bond areas of the substrate.

d. **Sakuyama** is drawn to surface mounting components on a board substrate and discloses separately applying unhardened resin and solder powder (i.e. paste) on the board (abstract). Sakuyama teaches first applying only resin on the bond areas 2 of the substrate 1, forming layer 3, and then subsequently applying the solder paste, forming solder layer 4. Thus, the resin is disposed between the paste and bond areas of the substrate. Sakuyama discloses that such method obtains sufficient solder layer 4 even on pads 2 having small dimensions and eliminates defective bonding (abstract). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the method of AAPA to supply unhardened resin on the substrate, and then subsequently print the solder paste on the resin similar to Sakuyama in order to eliminate defective bonding even with small pad dimensions. Moreover, the claim would have been obvious because a particular known technique (applying resin and then paste on top) was recognized as part of the ordinary

capabilities of one skilled in the art and would have yielded the predictable result of providing reliable joints between the components and the substrate. As the process of AAPA in view of Sakuyama is indistinguishable from the claimed process, it would necessary flow that during the heating step, the solder paste would flow through the reinforcing resin and contact the bonds areas of the substrate in order to interconnect the substrate and the electronic components.

e. Examiner appreciates that AAPA teaches additional step of applying underfill resin 31 after solder bonding the components. However, the rejection above is not concerned with any subsequent step after bonding the components. More importantly, Examiner points out that the rejection does not substitute the underfill resin of AAPA with the resin of Sakuyama. It is also noted that the present claims do not preclude additional step of applying underfill, wherein the final bonded assembly would contain both the resin of Sakuyama and the underfill resin of AAPA.

3. **Claim 2** is rejected under 35 U.S.C. 103(a) as being unpatentable over Sakuyama et al. (JP 06061636 A) in view of AAPA OR AAPA in view of Sakuyama as applied to claim 1 above, and further in view of Crane et al. (US 6667194, of record).

f. **As to claim 2,** Sakuyama discloses a resin layer 3, which is equivalent to sheet-form resin as shown in fig. 1b. Nonetheless, **Crane** et al. (drawn to bonding bumped components on a substrate using epoxy resin) discloses a coated sheet resin layer 20 on bond areas 18 of the substrate 16 (fig. 1). It would have been obvious to a person of ordinary skill in the art at the time of the

invention to provide a sheet-form resin similar to Crane in the method of Sakuyama and AAPA since such is an art-recognized alternative form of resin.

g. Neither AAPA nor Sakuyama expressly discloses cooling the resin and the paste. However, such technique is known in the art. After reflow, **Crane** discloses cooling the assembly, thereby solder-bonding the components on the substrate, and hardening (curing) the resin (col. 34, lines 7-17). It would have been obvious to a person of ordinary skill in the art at the time of the invention to perform cooling subsequent to reflow step as shown by Crane in the method of Sakuyama and AAPA because hardening the resin ensures high joint reliability.

4. **Claims 3-5** are rejected under 35 U.S.C. 103(a) as being unpatentable over Sakuyama et al. (JP 06061636 A) in view of AAPA and Crane OR AAPA in view of Sakuyama and Crane as applied to claim 2 above, and further in view of Nakamura et al. (US 6365499, of record).

h. **As to claim 3-5,** none of the references above discloses the sheet-form resin including equally spaced apertures forming a matrix of pores. However, such is also known in the art as shown by Nakamura et al. ("**Nakamura**"). Similar to resin 20 of Crane, Nakamura discloses supplying a sheet-form resin 43 on the circuit substrate 40 (fig. 5B; col. 10, lines 16-20). Nakamura discloses the sheet-form resin including recesses/holes (44) at positions that match the electrode bond areas (42) on the circuit substrate (40- fig. 5c).The claims would have been obvious at the time of the invention because supplying a sheet-form resin having an equally spaced apertures is an art-recognized alternative resin structure. One

skilled in the art would have been motivated to provide the claimed sheet-form resin in the modified bonding method of Sakuyama and AAPA in order to match the metallization patterns on the substrate.

5. **Claims 6-14** are rejected under 35 U.S.C. 103(a) as being obvious over Gonzalez et al. (US 2003/0080437, of record) with supporting evidence of Hayama et al. (US 6051448, of record).

i. **As to claim 6,** Gonzalez et al. ("**Gonzalez**") discloses an electronic component mounting method in which joints are formed between a substrate and electronic components using a reinforcing resin (figs. 6-8). Gonzalez discloses pre-coating the pads 32 (bond areas) of the substrate 30 with a solder paste as known in the art (fig. 8a- step 203; ¶ 30). Although Gonzalez does not expressly disclose "printing" solder paste, the step of pre-coating the paste on one or both surfaces to be joined (bumps and pads) is equivalent to printing. Nonetheless, **Hayama** et al. (drawn to method of manufacturing an electronic component) discloses that it is known to print patterns of paste on a substrate in forming conventional components (col. 1, lines 20-25). Thus, it would have been obvious to print the solder paste in the method of Gonzalez since printing a solder paste on the pads of substrate is a known technique of depositing paste and would have yielded the predictable result of bonding components to one of ordinary skill in the art at the time of the invention. In accordance with broadest reasonable interpretation, the coated/printed solder paste in the method of Gonzalez is restricted in fluidity since the deposited paste layer retains a given shape.

j. Gonzalez further discloses applying a thermosetting reinforcing resin (such as epoxy resin) on the substrate including the solder paste (fig. 8- 205, ¶ 45). Gonzalez then teaches placing the components 130 having solder bumps 132 on the substrate (¶ 49), soldering the components (¶ 53), and hardening the reinforcing resin (fig. 8b).

k. **As to claim 7,** it is reasonable to expect that solder paste would deform during placement of the components since suitable pressure is applied to cause the bumps to physically contact the pads on the substrate (Gonzalez- fig. 8a- step 209).

l. **As to claims 8-10,** Gonzalez discloses drying the solder paste using a heater (reflow - fig. 8b, ¶ 60-62), and such heating intrinsically volatilizes the solvent of the like in the paste.

m. **As to claim 11,** Gonzalez discloses the reinforcing resin being applied on a specified area.

n. **As to claims 12-13,** Gonzalez discloses the resin composition having a flux effect (¶ 57) and an effect of bonding (fig. 8b).

o. **As to claim 14,** the mounted electronic components of Gonzalez are retained by deformation of the solder paste and by adhesive power of the reinforcing resin.

6. **Claims 20-21** are rejected under 35 U.S.C. 103(a) as being unpatentable over applicant admitted prior art ("AAPA") in view of Sakuyama et al. (JP 06061636 A), Nishida et al. (US 6981317), and further in view of Wang (US 6773958).

p. **Regarding claim 20, AAPA** discloses an electronic component mounting method (**fig. 10**) in which joints between a circuit substrate (21) and electronic components (25/26) are made using solder paste (28). AAPA discloses placing components (26) having solder bumps (26a) on the circuit substrate (fig. 10c) and heating the assembly to bond the components on the substrate (fig. 10d).

q. AAPA discloses printing solder paste on the bond area (fig. 10b), but fails to teach printing the paste on a reinforcing resin such that the resin is between the paste and bond areas of the substrate. **Sakuyama** is drawn to surface mounting components on a board substrate and discloses separately applying resin and solder powder (i.e. paste) on the board (abstract). Sakuyama teaches first applying only resin (thermosetting) on the bond areas 2 of the substrate 1, forming an adhesive layer 3, and then subsequently forming a solder layer 4. Thus, the resin is disposed between the solder paste and bond areas of the substrate. Sakuyama discloses that such method obtains sufficient solder layer 4 even on pads 2 having small dimensions and eliminates defective bonding (abstract). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the method of AAPA to supply unhardened resin on the substrate, and then subsequently print the solder paste on the resin similar to Sakuyama in order to eliminate defective bonding even with small pad

dimensions. Moreover, the claim would have been obvious because a particular known technique (applying resin and then paste on top) was recognized as part of the ordinary capabilities of one skilled in the art and would have yielded the predictable result of providing reliable joints between the components and the substrate.

r. Examiner appreciates that AAPA teaches additional step of applying underfill resin 31 after solder bonding the components. However, Examiner points out that the rejection does not substitute the underfill resin of AAPA with the resin of Sakuyama. It is also noted that the present claims do not preclude additional step of applying underfill, wherein the final bonded assembly would contain both the bonding resin of Sakuyama and the underfill resin of AAPA.

s. Neither AAPA nor Sakuyama discloses the reinforcing resin sheet having an adhesive power higher on one side of the sheet than an adhesive power of an opposite side of the sheet. **Nishida** is drawn to mounting components to a circuit board and similar to Sakuyama, Nishida discloses supplying an unhardened reinforcing resin sheet (6 & 6a as a whole) on pads 5 of substrate 4 (fig. 1d). A bonding tool 7 applies sufficient pressure and heat to properly bond the resin sheet on the pads 5 (col. 10, lines 33-39). Nishida teaches that a separator layer 6a is provided on top side of resin sheet to prevent the thermosetting resin sheet 6 from sticking to the tool 7 (col. 10, lines 40-43). Thus, the adhesive power of one side (bottom side contacting substrate 4- fig. 1d) of the resin sheet 6 is higher than an opposite side (top side 6a). It would have been obvious to a

person of ordinary skill in the art at the time of the invention to supply a resin sheet in a manner similar to Nishida in the process of AAPA and Sakuyama in order to effectively bond the resin sheet to the pads while preventing sticking of the resin sheet with a bonding tool. Moreover, the claim would have been obvious because the substitution of one known element (bonding resin sheet) for another would have yielded predictable results to one of ordinary skill in the art.

t. Hence, the process of AAPA as modified by Sakuyama and Nishida includes the steps of: supplying an unhardened resin sheet on substrate, wherein the top side of the resin sheet has a lower adhesive power (due to separator layer); printing a solder paste on the treated reinforcing resin; placing bumped components on the substrate; and heating the assembly to bond the components on the substrate. Since AAPA in view of Sakuyama and Nishida is indistinguishable from the claimed process, it would necessary flow that during the heating step, the solder paste would flow through the reinforcing resin and contact the bonds areas of the substrate in order to interconnect the substrate and the electronic components.

u. None of the references above expressly discloses the step of cooling. However, **Wang** (also drawn to component mounting method) teaches that it has been known in the art that after heating, the substrate package is cooled to harden the electrical connections (col. 1, lines 50-57). Wang teaches solder-joining and curing between the component and substrate in the same heating and cooling operation in order to avoid thermal mismatch stresses (abstract). It

would have been obvious to a person of ordinary skill in the art at the time of the invention to perform cooling in the modified method of AAPA since such is conventional and would harden the electrical connections to provide a reliable joint. Moreover, one of ordinary skill in the art would have been motivated to perform heating and cooling operation in a manner taught by Wang in the method of AAPA because doing so avoids thermal mismatch stresses and thus prevents crack damage to components or substrate (Wang).

v. **As to claim 21**, AAPA in view of Sakuyama and Nishida includes a top side of the resin sheet having lower adhesive strength compared to the bottom side of the resin sheet contacting the substrate.

7. **Claims 22-24** are rejected under 35 U.S.C. 103(a) as being unpatentable over AAPA in view of Sakuyama, Nishida, and Wang as applied to claim 20 above, and further in view of Crane et al. (US 6667194) and Nakamura et al. (US 6365499).

w. **As to claim 22-24,** none of the references above discloses the sheet-form resin including equally spaced apertures (recesses/holes). **Crane** et al. (drawn to bonding bumped components on a substrate using epoxy resin) discloses a coated sheet resin layer 20 on bond areas 18 of the substrate 16 (fig. 1), which is analogous to resin sheet 3 of AAPA and Sakuyama. It would have been obvious to a person of ordinary skill in the art at the time of the invention to provide a sheet-form resin similar to Crane in the modified method of AAPA since such is an art-recognized alternative form of resin. Similar to resin sheet of Crane, **Nakamura** discloses supplying a sheet-form resin 43 on the circuit substrate 40

(fig. 5B; col. 10, lines 16-20). Nakamura discloses the sheet-form resin including recesses/holes (44) at positions that match the electrode bond areas (42) on the circuit substrate (40- fig. 5c). In view of collective disclosures of Crane and Nakamura, the claims would have been obvious at the time of the invention because supplying a sheet-form resin having an equally spaced apertures is an art-recognized alternative resin structure. One skilled in the art would have been motivated to provide the claimed sheet-form resin in the modified bonding method of AAPA in order to match the metallization patterns on the substrate.

Response to Amendment and Arguments

Applicant's arguments with respect to claims 1 and 6 have been fully considered but they are not persuasive.

Regarding claim 1, Applicant argues that neither AAPA nor Sakuyama discloses printing a solder paste on the resin. In response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on the combination of references (AAPA and Sakuyama collectively). See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.,* 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

Applicant further argues that the melting process steps of two prior art documents in combination are self-contradictory because AAPA applies reinforcing resin *after* solder bonding while Sakuyama applies resin and solder powder onto the bonds areas then performs solder bonding. In response, Examiner submits that manner

of applying resin is not interchanged in the proposed combination. In fact, it was pointed out that the rejection does not substitute the underfill resin of AAPA with the bonding resin of Sakuyama. It is also noted that the present claims do not preclude additional step of applying underfill, wherein the final bonded assembly would contain both the resin of Sakuyama and the underfill resin of AAPA as they serve different purposes.

Applicant also argues that Examiner dismisses the feature of applying underfill resin after solder bonding the components and there is no basis to ignore portions of the disclosure that undermine the viability of the proposed combination. In response, Examiner contends that the argued feature is not ignored, but rather, the rejection states that the final bonded assembly would contain both the resin of Sakuyama and the underfill resin of AAPA.

With respect to claim 6, Applicant argues that Gonzalez does not disclose first printing a solder paste and then restricting the fluidity (i.e. drying) of the solder paste as recited in the claim. First, Examiner contends that "restricting the fluidity" is NOT inherently equivalent to drying as alleged by Applicant and thus, it is noted that the features upon which applicant relies (i.e. drying) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. Secondly, as stated in the rejection, the solder paste as coated/printed is interpreted to meet "restricted in fluidity" since it retains a given shape (i.e. does not flow away). Thus, Examiner submits that Gonzalez discloses printing a solder paste, restricting the fluidity, and applying a reinforcing resin in the claimed order (fig. 8a). Applicant also argues that as Gonzalez merely discloses

an ordinary reflow process wherein heat treatment is performed after joining of the components. In response, Examiner notes that the present claim does not require any specific order of heat treating and joining the components and merely recites "solder-bonding and hardening the resin".

Applicant's arguments with respect to new claims 20-24 have been considered but are moot in view of the new ground(s) of rejection set forth above.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection (for new claims) presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

The rejections above rely on the references for all the teachings expressed in the text of the references and/or one of ordinary skill in the art would have reasonably understood from the texts. Only specific portions of the texts have been pointed out to emphasize certain aspects of the prior art, however, each reference as a whole should

be reviewed in responding to the rejection, since other sections of the same reference and/or various combinations of the cited references may be relied on in future rejections in view of amendments.

Applicant is reminded to specifically point out the support for any amendments made to the disclosure. See 37 C.F.R. 1.121; 37 C.F.R. Part 41.37; and MPEP 714.02.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to DEVANG PATEL whose telephone number is (571)270-3636. The examiner can normally be reached on Monday thru Thursday, 8:00 am to 5:30 pm, EST..

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jessica Ward can be reached on 571-272-1223. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/D. P./
Examiner, Art Unit 1793

/Jessica L. Ward/

Supervisory Patent Examiner, Art Unit 1793